Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Revision of Part 15 of the Commission's Rules	)	ET Docket No. 98-153
Regarding Ultra-Wideband Transmission Systems	)	

COMMENTS OF THE
NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

The National Academy of Sciences, through the National Research Council's Committee on Radio Frequencies (hereinafter, CORF[1]), hereby submits its comments in response to the Commission's March 12, 2003, Further Notice of Proposed Rulemaking in the above-captioned docket (FNPRM). In these Comments, CORF opposes the proposal to amend Part 15 rules regarding ultra-wideband (UWB) transmission systems to permit frequency-hopping systems in the 22-29 GHz band. Such systems would pose a significant threat of interference to remote sensing instruments, and thus to the important data being gathered by such instruments.

I. Introduction: The Importance of Remote Sensing, and EESS Observations in the 22-24 GHz Band.

CORF has a substantial interest in this proceeding, as it represents the interests of the passive scientific users of the radio spectrum, including users of the Earth Exploration Satellite Service (EESS) bands. EESS observers

[1] A roster of the committee is attached.

perform research that is extremely important yet vulnerable to in-band and out-of-band interference.

As the Commission has long recognized, remote sensing, which includes research done by users of the EESS, is a critical and unique resource for monitoring the global atmospheric and surface state. Satellite-based microwave remote sensing represents the only practical method of obtaining uniform-quality atmospheric and surface data encompassing the most remote oceans as well as densely populated areas of Earth. EESS data have contributed substantially to the study of meteorology, atmospheric chemistry, oceanography, and global climate change. Currently, instruments operating in the EESS bands provide regular and reliable quantitative atmospheric, oceanic, and land measurements to support an extensive variety of scientific, commercial, and government (civil and military) data users. Major governmental users of the EESS data include the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation, the National Aeronautics and Space Administration (NASA), and the Department of Defense (especially the U.S. Navy). Applications of the data include aviation forecasts, hurricane and severe storm warning and tracking, seasonal and interannual climate forecasts, decadal-scale monitoring of climate variability, medium-range forecasting, and studies of the ocean surface and internal structure, as well as many others.

Of particular concern to CORF in this proceeding are EESS observations at 22-24 GHz. The 23.6-24.0 GHz band is allocated to passive

scientific observers, including EESS and the Radio Astronomy Service. The 22.21-22.5 GHz band is allocated on a co-primary basis to passive scientific users including EESS, as well as to the Fixed and Mobile (except aeronautical mobile) Services. For remote sensing science, these bands reflect the existence of nearby water vapor absorption lines, and observations in these bands are important for measurements of atmospheric humidity (total integrated water vapor).

One of the most important components of Earth's atmosphere, water is essential for human existence. The global water cycle is a key to Earth's climate system, and accurate predictions of the cycle are necessary for monitoring climate variability and change, weather forecasting, and sustainable development of water resources. Such data are critical for making predictions of regional drought or flooding.

Several U.S. satellites currently make observations in these bands. As noted in the FNPRM, these include the Advanced Microwave Scanning Radiometer (AMSR) and the AMSR-EOS (AMSR-E). In addition, the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) operates aboard a NASA satellite. At least three more U.S.-sponsored spaceborne sensors are planned that will observe in these bands:

> --The Advanced Technology Microwave Sounder (ATMS) is currently being developed by NASA for the next-generation polar-orbiting weather satellite, called the National Polar Orbiting Operational Environmental Satellite System (NPOESS). The ATMS system is now being constructed and is scheduled to be in orbit by approximately 2007-2008.

--The Conical Scanning Microwave Imager and Sounder (CMIS) will also orbit aboard the NPOESS. This instrument will collect global microwave radiometry sounding data, including atmospheric temperature and moisture profiles, and data on clouds and sea-surface winds. CMIS is now in the engineering design stage and is scheduled to be in orbit by approximately 2008. CMIS is funded by the Integrated Program Office, which is staffed by personnel from the Department of Defense, the Department of Commerce/NOAA, and NASA.

--The Global Precipitation Measurement Microwave Imager (GMI) is a joint project of NASA and the National Space Development Agency of Japan. A follow-up to the TRMM instrument, GMI is designed to improve ongoing efforts to predict climate by making near-global measurements of precipitation, its distribution, and physical processes; and to improve the accuracy of weather and precipitation forecasts by more accurately measuring rain rates and latent heating. Launch of this instrument is scheduled for 2007.

These new instruments will provide important data on atmospheric moisture and temperature, sea-surface water temperature and wind speed, snow cover, and soil moisture for two to three decades to come. It is essential to protect the ability of the current instruments, as well as those coming online, to take these critical measurements.

II. CORF Opposes Amending the Commission Rules to Permit Frequency-Hopping UWB Systems in the 22-29 GHz Band.

As noted in paragraph 156 of the FNPRM, Siemens VDO Automotive AG (Siemens) has filed a petition seeking an amendment of the Commission's rules that would permit the operation of frequency-hopping UWB systems as vehicular radar systems in the 22-29 GHz band. Under the Siemens proposal,

such systems would be permitted to comply with the RMS average emission limits based on measurements averaged over a 10 millisecond (ms) period, rather than on measurements with the frequency hopping stopped. The FNRPM then goes on to note Siemens' claim that the effect of its proposed 10 ms averaging time would be no different from that of non-frequency-hopping UWB devices, "when the integration time of space borne passive sensors is taken into account." But the FNPRM then states that "[Siemens'] claim is not justified . . ." while noting that the AMSR sensor has a 2.6 ms integration time and the AMSU-A sensor [actually the AMSU-A2 module] has integration times of 158-165 ms, and that the integration times of future satellites could vary. *Id*. at para. 157. Lastly, the Commission expresses its concern that devices allowed under the Siemens proposal could generate greater levels of interference than non-frequency-hopping devices, because the extended measurement period could allow frequency-hopping devices to momentarily emit at a much higher level at a particular frequency. *Id.* at para. 159.

CORF shares the Commission's concern. The effect on EESS systems of high-level, low-duty-cycle interference is not the same as that of lower-level, high-duty-cycle interference of the same average transmitted power, unless the averaging time over which the equivalence is established is shorter than the expected integration time of the EESS measurement. If the averaging time is not shorter than the integration time, then the effective level of interference will grow as the ratio of the averaging time over which

equivalence is established to the EESS integration time. EESS integration times are determined by the angular resolution and scan geometry of the sensor. The highest-resolution (and hence shortest integration time) EESS instrument currently operating in the 23.6-24.0 GHz band is the NPOESS CMIS, with an integration time of 1.2 ms.

The 1.2 ms integration time for the CMIS reflects a natural and steady progression beyond last-generation 23.6-24.0 GHz EESS systems, which had integration times on the order of 10 ms. Given the continuing drive in technology toward enhanced angular resolution imagery, it is reasonable to assume that instruments scheduled to go into operation in the next few years will operate with integration times in the range of several tenths of a millisecond. The Siemens proposed averaging time of 10 ms with which to estimate equivalent continuous duty-cycle interference is roughly two orders of magnitude longer than that needed to be consistent with instruments scheduled to go into operation in the next few years. Accordingly, CORF opposes amendment of the Commission's rules to allow frequency-hopping devices at 22-29 GHz. However, if such devices are to be authorized, then CORF suggests that an averaging time of 0.1 ms be used to determine compliance with interference requirements, using the measurement procedure described below.

In para. 161 of the FNPRM, the Commission seeks comments on the measurement procedure for checking compliance of UWB frequency-hopping devices with Commission rules. First, if such devices are to be authorized,

then as noted above CORF suggests that the measurement should be done over a 0.1 ms averaging time period, instead of a 10 ms period. Assuming a 0.1 ms averaging time period, the measurement has to answer the question: What is the maximum possible time-averaged level of interference that can be generated over a 0.1 ms interval across the 23.6-24.0 GHz band? Since the source of interference is frequency hopping asynchronously with the 0.1 ms averaging time, it is necessary to take an adequately large number of 0.1 ms samples in order to provide a reliable estimate of the statistical maximum. A swept frequency mode of measurement by a spectrum analyzer is prone to sampling errors if the sweep time, averaging time, and frequency-hopping cycle times are not properly adjusted to prevent undersampling and/or aliasing. A preferred method of measurement would be a fast-response (0.1 ms or faster) power detector measurement with the signal entering the power detector head properly filtered beforehand to define the passband of interest (23.6-24.0 GHz or otherwise). Many measurements (e.g., several seconds at 0.1 ms per sample) should be taken and the maximum value noted. This process should be repeated a number of times to ensure that the estimate of the “maximum” statistic is accurate and repeatable.

III. Conclusion.

For the reasons set forth above, CORF urges the Commission not to amend Part 15 rules regarding ultra-wideband transmission systems to permit frequency-hopping systems in the 22-29 GHz band.

Respectfully submitted,

NATIONAL ACADEMY OF SCIENCES'
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